

## 16.

Notes on the Biology and Ecology of Giant Tuna, *Thunnus thynnus* Linnaeus, Observed at Portland, Maine<sup>1</sup>.

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(Plate I; Text-figure 1).

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## INTRODUCTION.

The material for the following paper was gathered during the latter part of July, 1936, at Portland, Maine. For their unflinching cooperation, I wish to express my thanks to Mr. George L. Ratcliffe, President of the Portland Fish Co., to Dr. J. S. Jamieson of the same city, and to Mr. Walter H. Rich, Portland agent of the U. S. Bureau of Fisheries.

My thanks are also due to Mr. John Tee-Van of the New York Zoological Society and to Mr. Martin D. Burkenroad of the Peabody Museum for determinations of food samples, and to Dr. William Beebe for initiation and supervision of the work.

## MATERIALS AND METHODS.

A total of 34 newly-caught tunas was examined, ranging from 41 inches in standard length and 65 pounds in weight (undressed), to 97 inches and

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860 pounds. Gill-raker counts and food diagnoses were made in every case, the sex was determined in all but four, and partial or complete measurements and counts were secured from 10 specimens.

The methods of harpooning the tuna were observed by accompanying a fishing boat to sea, and in this way color notes of two living specimens were obtained and parasites preserved.

The giant tuna or horse mackerel are fairly common just outside Casco Bay during the summer months, and their capture is becoming an industry of increasing importance. Except for the few specimens which are caught by sportsmen on rod and reel, all of the tuna taken are harpooned by the native fishermen. The fishing launches, twenty to thirty-five feet in length, are each rigged with a platform or "pulpit" in the bow, and from here the harpooner makes his strike. Manned by a motorman and a single fisherman, the boats leave the wharf early in the morning, run straight out to the mouth of Casco Bay, and spend the day searching for tuna schools. While the fish are often found along the very entrance to the Bay, they must sometimes be followed far out to sea, 15 or 20 miles from the dock. When fish are sighted, the motorman approaches the school and follows it, manoeuvring to give the harpooner in the bow a chance to strike with the 12- or 15-foot "pike." Sometimes he must cast the pole as much as 25 feet or more, or submerge its full length under water. The largest fish taken during my stay (860 pounds) was harpooned as it swam at least 15 feet in advance of the bow and an equal distance under water. Small fish are usually brought alongside with scarcely any struggle, while large specimens sometimes fight several hours. Often no fish at all are caught by a given boat during the day, while at other times eight or ten will be taken.

For a complete account of the tuna fisheries of Maine, as well as for data on the numbers and weights of tuna caught during several recent seasons, see "The Horse Mackerel (Tuna) Fishery of Maine;" Department of Commerce, Bureau of Fisheries, Mem. S. 339, 1935, by Walter H. Rich.

#### DESCRIPTION OF *Thynnus thynnus* L., BASED ON SPECIMENS STUDIED AT PORTLAND.

**COLORS:** (From two specimens measuring 49 and 96.5 inches, standard length [ca. 100 and 860 pounds, respectively], examined at sea when caught; the smaller fought scarcely five minutes, and was very active when lifted into the boat, while the larger struggled nearly two hours and was almost dead upon examination, yet there was no essential color difference between the two. However, the color in both cases changed and faded entirely after ten minutes in the air).

**Body:** Dorsal surface blackish-bronze as far down as the dorsal margin of the eye or slightly lower; adjoining this a longitudinal stripe of bluish bronze running entire length of body and extending as low as the level of lower margin of pectoral fin base; rest of body silver. At death, the dorsal surface changed to greenish before losing color and becoming uniformly dark; the lateral stripe became brownish, then inconspicuous; and the ventral surface turned faintly violet, then dead white. Iris bronze.

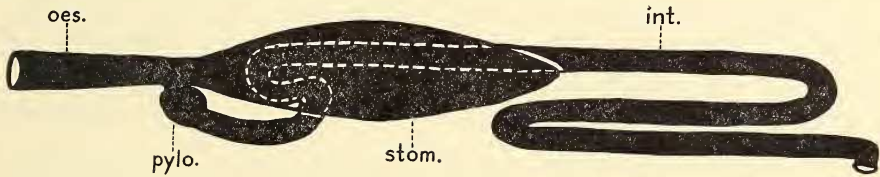
**Fins:** Pectoral and caudal very dark, almost black; second dorsal silver gray, darkening at death; anal paler; second dorsal lobe and anal lobe with a narrow greenish-yellow stripe close to posterior margin and extending out to tip of lobe. This stripe persisted hours after death, was identical in all specimens examined on the wharf, and was invariably paler and greener than the finlets. Finlets always bright golden yellow, the color persisting.

**MEASUREMENTS AND COUNTS:** The data given below were compiled from measurements and counts made upon ten specimens. Their standard lengths and undressed weights were as follows:

No.	Standard Length	Weight
1.	1046 mm. (41 in.)	65 lbs.
2.	1250 " (49 " )	ca. 105 "
3.	1658 " (65 " )	244 "
4.	1691 " (66.3 " )	189 "
5.	1900 " (74.5 " )	ca. 550 "
6.	2015 " (79 " )	ca. 600 "
7.	2142 " (84 " )	ca. 700 "
8.	2410 " (94.5 " )	ca. 700 "
9.	2460 " (96.5 " )	860 "
10.	2474 " (97 " )	772 "

*External:* Depth in standard length 2.8 to 3.3; head in length 3.2 to 3.9; eye in head 7.7 to 10.7; snout in head 2.3 to 3; tip of snout to middle of eye in head 2 to 2.5; maxillary in head 2.4 to 2.7; interorbital in head 1.9 to 2.8; snout to pectoral in length 3 to 3.5; snout to pelvic in length 3.1 to 3.3; snout to first dorsal in length 2.9 to 3.4; snout to second dorsal in length 1.7 to 1.8; snout to anal in length 1.4 to 1.6; height of first dorsal fin in head 2.3 to 2.6; height of second dorsal fin in head 1.6 to 2.4; height of anal fin in head 1.9 to 2.4; pectoral fin length in head 1.4 to 1.9; end of pectoral fin under 9th to 12th dorsal spine; caudal length in length 6.3 to 10.0; caudal spread in length 2.8 to 3.2. Pectoral rays I, 31 to I, 33; dorsal count XIV + I, 11 + 9 to 11; anal count I, 10 to 11 + 8 to 10. Gill-rakers 11—25 to 14—27 (see below). In every case the anal origin was distinctly behind the insertion of the last dorsal ray.

*Internal:* Length of stomach in length 3.9 to 5.6; length of longest liver lobe in length 7.5 to 10.4; liver unspotted, of four major lobes and a varying number of small lobes; length of caeca sac in length 4.3 to 5.2; length of testicle in length 2.4 to 2.8 (latter in small specimens).



Text-figure 1.

The alimentary canal of a young specimen of *Thunnus thynnus* (standard length 41 in., weight 65 lbs.) taken at Portland, Maine. *Oes.*, oesophagus; *pylo.*, pylorus; *stom.*, stomach; *int.*, intestine. (x 1/5).

**GILL-RAKER COUNTS:** The gill arches of 34 specimens were examined, of which 13 had both sides intact, the others having been damaged during the dressing of the fish. Of these 13, only four specimens had the same gill-raker count on both sides. As will be seen from the following table of frequencies, the most usual counts were 13—25 and 13—26, while the extremes ranged from 11—25 and 12—24 to 14—27, giving a total of 36 to 41 gill-rakers on the first branchial arch. In the cases where the count was unequal on the two sides, the largest number occurred indiscriminately on either right or left side. Broken arches, in which only the upper or lower count could be taken, are omitted from the table.

<i>Gill-raker Count</i>	<i>Frequency</i>
11—25	1
12—24	2
12—25	2
12—26	2 (a pair)
13—24	2
13—25	7 (incl. 1 pair)
13—26	11 (incl. 3 pairs)
13—27	5
14—24	1
14—25	4
14—26	1
14—27	2

**GROWTH CHARACTERS:** There are a few consistent age differences apparent in the series under consideration: In the smaller specimens, the dorsal and anal lobes are relatively lower, the stomach is slightly shorter, the liver has not as many small, sub-lobes and the reproductive organs are poorly developed.

#### ECOLOGY.

**SIZE AND WEIGHT:** Reports of Portland tuna smaller than 33 pounds can not be verified, and even these relatively small fishes are exceedingly rare. It is probable, however, that much smaller tuna are sometimes taken in the mackerel nets; John Doughty, an experienced tuna fisherman, took a two and one-half pound fish from one of these nets last year, which he is certain was a true tuna; he states that the shape of the fish, the appearance of the fins and the color and arrangement of the finlets all were typical of a tuna.

The largest tuna harpooned are supposed to have reached 1,600 pounds, but these weights are unofficial, having been taken from a newspaper report. Recorded weights for Portland fish reach 967 pounds. The majority weigh between 300 and 700 pounds.

When the tuna appear off Portland in the early summer (see below), they are always much thinner than later on. However, large fish which are caught on the same day in mid-summer and which are equal in length, may differ almost a hundred pounds in weight (see measurement table, p. 209); in the case observed, at least, sex was not a factor, as both of the largest specimens listed were spent males.

**SEX:** Every one of the 30 specimens examined was a male. Of these, five of the largest (weighing 700 pounds and over) had broadly distended sperm ducts and spent testicles. In all of the others the testicles were far from being in breeding condition, while the sperm ducts were extremely slender.

**OCCURRENCE:** Every year the first tuna appear in the latter part of June, are common in July and August, and become scarce in September. They vanish altogether early in October. Their season corresponds exactly to that of the herring and mackerel. Usually the tuna remain outside of Casco Bay in at least 35 or 40 fathoms of water and 12 or more miles from the dock. This year, however, they have occasionally been seen further inshore. There is no report of the occurrence of any other species of tuna in this area.

**SCHOOLING:** Fish of approximately the same size form small schools of which up to twenty or more may be visible at the surface at once, leaping or swimming slowly along with the tips of their fins breaking water. Small and large fish are never seen in the same school. As a rule, the smaller

the fish, the more individuals in the school, while the largest fish often seem to be solitary.

PARASITES: The 860-pound specimen mentioned earlier in the paper had many dark red *Caligus* sp. on the bases of the anal fin, of the dorsal and anal finlets and of the caudal fin. A few were found on the finlets and the caudal fin. There were *Distoma*-like worms in about half a dozen of the 34 stomachs examined.

FOOD: The following food was present in the 34 stomachs examined:

<i>Food</i>	<i>Nos. of stom- achs in which it occurred</i>
<i>Merluccius bilinearis</i> (from 1 to 38 fish in a single stomach, each measuring from 8 to 13 inches in length. In most of the tunas the food consisted entirely of this species).....	26
Seaweed (in stomachs containing little other food; only one or two fronds were found in each stomach).....	4
Squids (one or two in a stomach, alone or with shrimps).....	3
<i>Meganyctiphanes norvegica</i> (numerous; all adults).....	2
Clupeid, 215 mm.....	1
Clupeids, different from above; three, ca. 75 mm.....	1
<i>Sebastes marinus</i> ; four, 53 to 117 mm.....	1
<i>Tylosaurus marinus</i> ; one, 135 mm.....	1

Five of the tuna stomachs were completely empty. Almost all of the food was in an advanced state of digestion.

Previous records of the food of Maine tunas are few and indefinite. Bigelow ("Fishes of the Gulf of Maine," 1925, p. 213) states that the principal food consists of menhaden, mackerel and herring, with occasional dogfish, squid and the smaller schooling fishes. Rich (*loc. cit.*) also writes that herring, mackerel and menhaden are the most important elements of diet. The fishermen almost never open the stomachs, except by accident, and know only that tunas "often eat herring and mackerel." Since four genera of "herring" and five of "mackerel" occur in the Gulf of Maine, and since my few days' work yielded five kinds of organisms previously unrecorded as tuna food, the need for detailed and sustained work on this interesting subject is evident.

## EXPLANATION OF THE PLATE.

## PLATE I.

- Fig. 1. A typical tuna-fishing boat of Portland, Maine, showing bow platform. Photograph from Walter H. Rich.
- Fig. 2. A fisherman in position for a strike. Photograph from Walter H. Rich.
- Fig. 3. An 860-lb. specimen of *Thunnus thynnus* taken off Portland in July, 1936. Photograph by Dr. J. S. Jamieson.